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ABSTRACT

The Cognitive Education Project conducted a 3-year longitudinal evaluation of two cognitive education programs that were aimed at teaching thinking skills. The critical difference between the two experimental programs was that one, Feuerstein's Instrumental Enrichment (IE) method, was taught out of curricular content, while the other, the Strategies Program for Effective Learning/Thinking (SPELT), was taught directly within curricular content. The effectiveness of these two programs was compared with traditional instruction at grades 4 and 7 for 900 gifted, learning disabled, and normally achieving students. Results indicate that cognitive education was effective in improving student thinking, especially for the grade-4 learning disabled students and to a lesser extent the gifted students, in reading comprehension and comprehension monitoring. SPELT tended to produce more positive changes than did IE, and SPELT was better received by teachers, parents, and administrators, although both programs were favorably received. Two tables and 10 figures present study findings. (Contains 21 references.) (SLD)

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# Cognitive Education Project

## Summary Report

Robert Mulcahy and Associates

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# Cognitive Education Project

## Summary Report


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## Please Note

The views and recommendations expressed in this report are those of the researchers and not necessarily those of the Department of Education.

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County of Two Hills #21

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Stettler School District #1475
Wetaskiwin School District #264
Red Deer Roman Catholic Separate School District #17

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Nelly McEwen (Chair)
Glen Miller
Dale Bjornson
Sandra Pace
Clarence Rhodes
Tom Blowers
Doug Fleming
Janice Leonard

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## Abstract

The numerous reasons for teaching thinking have been tied to the perceived needs of the present and future technological society. Expectations are placed on individuals to be self-sufficient, responsible citizens, and part of an efficient work force, oriented toward an information age. Endorsement of this objective and attempts to teach thinking have resulted in the proliferation of many learning/thinking programs. Few studies to date have, however, systematically and longitudinally evaluated any of the available programs to determine which ones are most effective and most easily integrated into the regular school curriculum. More importantly, there is little empirical data comparing the efficacy of the programs at different grade levels or with different types of learners.

The purpose of the Cognitive Education Project, centered at the University of Alberta, was to undertake a three-year longitudinal evaluation of two cognitive education programs. The critical difference between the two experimental programs was that one (Feuerstein's Instrumental Enrichment - I.E.) was taught out of curricular content, while the second program (Strategies Program for Effective Learning/Thinking - S.P.E.L.T.) was taught directly within curricular content.

Specifically, the effectiveness of the I.E. and S.P.E.L.T. cognitive education programs was compared with traditional instruction at two initial grade levels (grades 4 and 7) for three diagnostic groups (gifted, learning disabled and normal achievers). The comparison was done in terms of:

a. the effects of the programs on students' affect and motivation, academic achievement, cognitive ability, and learning/thinking and problem solving strategies;
b. the differential impact of the programs;
c. the feasibility of implementing learning/thinking strategies instructional programs as part of the regular curriculum of schools; and
d. identifying appropriate methods for providing the level and quality of teacher training necessary for implementation.

These general objectives gave rise to a number of questions spanning student, teacher, parent and administrator responses. The study was implemented in two phases starting in 1984 and 1985 respectively and overlapping, with phase 1 ending in 1987 and phase 2, in 1988. It utilized a repeated measures factorial design involving three types of instructional programs, three categories of students, and two initial grade levels (grades 4 and 7). The complete study provided four data points.

In the course of the implementation, teachers of the control condition taught as usual, whereas teachers assigned to the two cognitive education procedures received intensive inservice training prior to classroom strategy instruction.

In identifying subjects for the study, intellectual, academic and behavioral characteristics were used, resulting in the selection of 900 students from an initial population of 4,000. Based upon intelligence test scores and achievement three groups of subjects were identified as gifted, average and learning disabled.

Apart from obtaining responses from students, questionnaires were administered to teachers, parents and administrators to assess their perceptions of the different programs. The results of the study indicate that:

1. Cognitive education was effective in improving student thinking, especially for the grade 4 learning disabled, and to a lesser extent the gifted, in reading comprehension, and comprehension monitoring skills. Students' strategic behavior generally improved across grade and diagnostic groups.

2. Though I.E. was effective, S.P.E.L.T. tended to produce more positive changes in students' overall performance.

3. Teachers', parents', and administrators' responses were positive towards the two cognitive education programs, with more favorable remarks being made for S.P.E.L.T. The teachers involved in the study indicated general appropriateness of both experimental programs especially for grade 4 students. The vast majority of experimental teachers said the inservices provided were appropriate and that they would continue to use the instructional procedures from their respective program. As well, the teachers said they would recommend the two programs to their colleagues. Parents also indicated observation of positive changes in their youngster's self-confidence, task persistence, accepting alternative points of view, originality of thinking and questioning, etc.

4. The question of whether either of the cognitive education programs was more effective for specific groups of children did not receive a definitive answer and may have to be further examined. On the whole, the experimental programs appeared to be most effective for learning disabled students, and to a lesser extent, the gifted at both grade levels.

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# The Cognitive Education Project
# Summary Report

The purpose of this report is to summarize the major features and findings of the Cognitive Education Project. First, the rationale, objectives and research questions of the project are outlined. These are followed by a brief description of the two cognitive education programs (Instrumental Enrichment and Strategies Program for Effective Learning/Thinking) selected for comparison in the project. Research methodology and findings are then presented. Finally, conclusions and recommendations are specified.

## Rationale

Over the past decade, there has been a significant increase in interest and desire from teachers, school districts, colleges, and universities to teach thinking skills. This interest has been associated with the emergence of various cognitive education programs aimed at enhancing students' cognitive and metacognitive skills. This has been done with the hope that students might become more independent learners and more efficient problem solvers.

Although cognitive education programs have been growing in number and popularity, many questions concerning their effectiveness remain. Part of the reason is the lack of long-term evaluation of these programs. First, the packages available today tend to vary in terms of scope, skill development, age/grade suitability, training requirements, curriculum integration, cost, and instructional methodology. Few studies to date have systematically evaluated any of the available programs to determine which ones are most effective and most easily integrated within the regular school curriculum. More importantly, there is little empirical work comparing the efficacy of the programs at different grade levels for different types of learners. The results of these studies are often equivocal with regard to program effectiveness.

Associated with this lack of comprehensive evaluation is the question of selecting from alternative approaches to teach thinking. That is, linking this evaluation issue to instruction, the central question becomes *how to teach learning/thinking*. Educators are faced with choosing between an **in-content** or **out-of-content** instructional approach. Which would work better for students? Would there be differences if we compare these two approaches at different grade levels for different types of learners?

Basing our conclusions and subsequent action on subjective preferences alone would be inadequate. The seeming course is to conduct an evaluation study: putting in-content and out-of-content programs in place in selected schools and evaluating the results. With this main purpose, the Cognitive Education Project (CEP) was inaugurated in the fall of 1984.

## Objectives and Research Questions

The Cognitive Education Project was a cooperative venture involving: 1) Alberta Education, Government of Alberta; 2) the Department of Educational Psychology, the University of Alberta; and 3) various school jurisdictions in north-central Alberta. It was established with the general purpose of undertaking a long–term evaluation of two cognitive education programs (out–of–content versus in–content) in relation to traditional instruction in elementary and junior high classrooms.

For the out–of–content approach, Feuerstein's Instrumental Enrichment (I.E.) was selected because it is one of the most comprehensive and field-tested learning and thinking programs available to date. It represents an out-of-content instructional approach utilizing paper-pencil tasks and intensive teacher-pupil discussion to teach learning/thinking skills. In contrast, the Strategies Program for Effective Learning/Thinking (S.P.E.L.T.) was chosen as an in-content instructional approach. It integrates the features of several prominent cognitive theorists and intervention procedures, and it emphasizes the teaching of learning/thinking strategies directly within content across the curriculum.

The effectiveness of cognitive education — represented by the I.E. and S.P.E.L.T. programs — was compared with the effects of traditional instruction at two initial grade levels (grades 4 and 7) for three diagnostic groups (gifted, learning disabled and average achievers). Specifically, the objectives of the project were fourfold:

1. to assess the relative effectiveness of the two programs in terms of their impact on students' affect and motivation, academic achievement, cognitive ability, and learning/thinking and problem-solving strategies;
2. to examine the differential effects of the programs on gifted, normal achieving, and learning disabled students;
3. to ascertain the feasibility of implementing learning/thinking strategies instructional programs on a large scale as part of the regular curriculum of schools; and

4. to identify appropriate methods for providing the level and quality of teacher training necessary for implementation.

In response to the objectives listed above, nine research questions were formulated.

1. What are the relative *effects* of the different cognitive education programs compared to traditional instruction on gifted, learning disabled, and average achievers with respect to the following dimensions?
   a. perceived competence
   b. perceived locus of control
   c. performance in reading comprehension
   d. performance in arithmetic problem solving
   e. use of specific strategies employed in solving problems
2. Is/are the training program(s) more *appropriate* at different ages for different diagnostic groups?
3. Do the pupils continue to *maintain* and/or alter their level of performance following the withdrawal of training?
4. What is the nature of strategy *monitoring* for each of the three groups across the different age/grade groupings? To what extent can the cognitive education programs be *implemented* as intended by program developers?
5 What is the nature of the strategies utilized by each of the groups across the different age/grade groupings *prior* to instruction and at the *conclusion* of the study?
6. What are parents', teachers', and administrators' *opinions* regarding the cognitive education programs?
7. What are the teachers' and administrators' *opinions* regarding inservice and consultative assistance provided for cognitive education programs?
8. What guidelines for preservice and inservice programs for teachers seem appropriate?
9. How well are the programs implemented by teachers of cognitive education? Do teachers learn and implement the cognitive education strategies? How appropriate and effective are the inservice and consultation provided?

## The Two Selected Programs — Instrumental Enrichment and Strategies Program for Effective Learning/Thinking

To clarify the characteristics of experimental treatments in the research methodology, the two cognitive education programs selected for comparison in the study are briefly described here.

### Instrumental Enrichment

Feuerstein's Instrumental Enrichment (I.E.) (Feuerstein, Rand, Hoffman, & Miller, 1980) was selected to represent the out-of-content approach to instruction. This program was originally designed for culturally disadvantaged children and youth. However, it is currently being used with a broader population of children in upper elementary, junior, and senior high schools. A distinguishing feature of I.E. is its emphasis on the importance of mediation for strategy development. Strategies are ways to facilitate the acquisition, manipulation, integration, storage and retrieval of information across situations and settings. For Feuerstein, training for such strategy development is through a "mediated learning experience". This means that an adult mediator elicits behaviors from the child that lead to the solving of the problem, and then the child comes to understand the goals and strategies of the task. Thus in I.E., social interaction is important, because it is believed that it is not the content, but the *means of interacting* that is internalized by the child.

The Feuerstein program utilizes pencil-and-paper tasks with related intensive teacher-student discussion. It consists of 15 'instruments' or pencil-and-paper exercises as follows: Organization of Dots; Analytic Perception; Orientation in Space I, II, III; Comparisons; Categorization; Instructions; Family Relations; Illustrations; Numerical Progressions; Temporal Relations; Stencil Design; Transitive Relations; and, Syllogisms. While the names of the individual instruments indicate the dimensions of the program, the program is intended to be content-free. The term content-free is intended to convey the idea that the contents of any particular exercise are merely a vehicle, or an instrument, to achieve the overall goals of the program. The major goal of I.E. is to enhance the cognitive modifiability, that is, learning potential, of the individual.

The I.E. program can be integrated into the regular school curriculum, but is taught in a decontextualized form first. Typically, I.E. instruction extends over a two- to three-year period, with a minimum of three sessions per week devoted to work on the instruments. An I.E. lesson normally begins with a ten-minute introduction, followed by

individual work, class discussion and summary. The teacher ensures that adequate mediational experiences are provided to students especially in the introductory and discussion stages. A typical lesson in I.E. appears to be highly perceptual with strong visual-motor factors; however, in reality, the product resulting from, say, the connecting of dots to form a pattern in the Organization of Dots instrument, is a very minor part of I.E. The program is characterized by students' discovering a pattern in the instruments through mediation; determining the underlying principle, then "bridging" this principle to other examples. It is this dynamic involvement of the teacher in a dialogue with the student, along with the change in orientation from product to process, that depicts this program.

**Strategies Program for Effective Learning/Thinking**

The Strategies Program for Effective Learning/Thinking (S.P.E.L.T.) (Mulcahy, Marfo, & Peat, 1984) was selected as the in-content program in the study. It was initially aimed at children in the upper elementary and junior high school grades. It has since been extended to high school and college populations. Similar to the I.E. program, the S.P.E.L.T. approach also aims to foster strategic learning and emphasizes the importance of the interactions between the teacher and students in the process of strategy development. In the S.P.E.L.T. program, cognitive strategies are conceptualized as internally organized skills or control processes by which learners regulate their cognitive and/or learning behavior. A learner's repertoire of strategies is thus seen as a set of tools that enables him/her to more effectively and efficiently activate and regulate important cognitive activities such as attention, comprehension, retention and retrieval of information, thinking, and problem solving. The teacher plays the role of a mediator between the learner and the external world, structuring the learning environment and providing opportunities necessary to establish and improve strategic behavior in learning, thinking, and problem-solving situations. A general teaching orientation is embedded within S.P.E.L.T. whereby the teacher's goal in all planning and instruction is to actively involve the student in the learning process (Peat, Mulcahy, & Darko-Yeboah, 1989).

S.P.E.L.T. however, differs from I.E. in its instructional context. While I.E. has been designed as a structured package to be taught independently of existing curriculum content, the S.P.E.L.T. approach holds that the teaching of learning/thinking strategies should take place within content and not as an independent or isolated curricular activity. With regular school curriculum as a vehicle, S.P.E.L.T. through inservice

demonstrates how the teacher can use specific strategies to activate and regulate students' learning activities.

Moreover, S.P.E.L.T. utilizes a three–phase instructional perspective. It progresses from the first phase — direct teaching of strategies in content areas — to the second phase — teaching for strategy transfer — and finally, to the third phase where students can themselves generate new strategies to acquire, analyze, and apply information and ideas. The active involvement of the students in the learning process is maintained as a goal throughout the three phases of S.P.E.L.T. instruction. For both Phases II and III, the teacher engages in Socratic Dialogue — an interactive relationship between the teacher and students, where the teacher leads the students through questioning to discover relationships for themselves. Thus, mediational teaching is also a feature of the S.P.E.L.T. program.

In sum, the common goal of the two programs is to help students learn 'how to learn' and thus become independent, organized, active, and purposeful thinkers and problem solvers. The critical factor for distinguishing between the two is the nature of integration of the program into the curriculum. I.E. is considered a *detached* program because it is first taught without using curriculum content and later integrated into the curriculum. On the other hand, S.P.E.L.T. is described as an *embedded* program because it is taught directly using curriculum content.

To evaluate the effectiveness of the out-of-content approach of I.E. versus the in-content approach of S.P.E.L.T. in relation to conventional instruction, the following research methodology was developed.

## Methodology

### Research design

The study was a three-year longitudinal evaluation study implemented in two phases (i.e., phase 1: 1984 - 87; and phase 2: 1985 - 88)[1]. It utilized a repeated measures factorial design involving the three types of instructional programs (I.E., S.P.E.L.T., and Control), three categories of students (gifted, average, and learning disabled), and two

[1] Due to budget restraints the study was conducted in two major phases. Phase I (1984 - 1987) began in October 1984 and ended in June 1987. Phase II (1985 - 1988) started in October 1985 and ended in June 1988. Thus, for each phase, it was a three-year period of evaluation. Nevertheless, for the whole study, it took four years (1984 - 1988) to complete.

initial grade levels (grade 4 and grade 7). The complete study involved four data points (repeated measures): pre-test in the fall of the initial year, and two post-tests in succeeding May/June periods corresponding to the end of grades 4 , 5, 7, and 8, and a maintenance post-test at the end of grades 6 and 9 (see Table 1).

**Table 1**

**Overall Study Design**

| | Oct. 84 | June 85 | Oct. 85 | June 86 | June 87 | June 88 |
|---|---|---|---|---|---|---|
| **Phase 1:** | | | | | | |
| Grade 4 | | | | | | |
| All* | PRE | PT1 | _ | PT2 | Maintenance | _ |
| Grade 7 | | | | | | |
| I.E. | PRE | PT1 | _ | PT2 | Maintenance | _ |
| CONTROL | PRE | PT1 | _ | PT2 | Maintenance | _ |

| | Oct. 85 | June 86 | June 87 | June 88 |
|---|---|---|---|---|
| **Phase 2:** | | | | |
| Grade 4 | | | | |
| I.E. | PRE | PT1 | PT2 | Maintenance |
| S.P.E.L.T | PRE | PT1 | PT2 | Maintenance |
| Grade 7 | | | | |
| All* | PRE | PT1 | PT2 | Maintenance |

* All refers to all 3 instructional conditions.

**Program implementation**

Teachers assigned to the control condition (traditional instruction) were told to teach as usual, whereas teachers assigned to the two cognitive education procedures received inservice training from project staff prior to giving strategy instruction. Thus students in the control condition received traditional instruction, while students involved in the two cognitive education programs received a minimum of 120 minutes of strategy instruction per week over two school years. Strategy instruction was followed by one year of maintenance, during which all strategy instruction was withdrawn. Since I.E. is an out-of-content program, teachers were required to take time out of a variety of curricular content areas to implement the program. Essentially, the I.E. instruction time was taken from language arts. For S.P.E.L.T., teachers incorporated strategy instruction across content areas, and language arts was the major content medium for the S.P.E.L.T. instruction.

**Subject identification**

Based on intellectual, academic and behavioral characteristics, about 900 pupils comprising gifted, average, and learning disabled students were identified from the total initial population of 2,400 students in 1984-85 and 1,600 students in 1985-86. Selection criteria were as follows:

The **gifted** students selected for this project were those who:

- obtained scores of 115 or higher on the verbal and the non-verbal sub-scales of the Canadian Cognitive Abilities Test (CCAT),
- were rated as being above average in achievement in reading and at/or above grade level in math on the Canadian Achievement Test (CAT),
- were rated as being above the mean (of the total study population) on all three of the Renzulli and Hartman Scales for the Rating of Behavioral Characteristics of Superior Students (SRBCSS) categories (i.e., motivation, learning and creativity characteristics).

The **average-achieving** students included in this study were those who:

- obtained scores within one standard deviation of the mean on both the verbal and nonverbal sub-scales of the CCAT (85-115),
- obtained achievement scores on the reading and math sub-scales of the CAT within approximately one standard deviation of the mean.

The **learning disabled** students identified in this study were those who:

- obtained scores within one standard deviation of the mean on both the verbal and nonverbal sub-scales of the CCAT (85 - 115),

- obtained achievement scores of approximately one standard deviation or more below the mean on the reading sub-scale of the CAT.

It can be seen that in the subject identification process, reading was chosen as the major academic measure because it is one of the most important skills necessary for school success. Furthermore, the majority of learning disabled children experience learning difficulties in this area. Consequently, it was the critical achievement measure used in the identification of all three diagnostic groups (i.e., gifted, average and learning disabled).

**Assessment of program effects**

The instruments utilized in this study can be grouped into four categories: (1) cognitive ability, (2) academic achievement, (3) affective perceptions, and (4) cognitive strategies.

To assess general **intellectual/cognitive ability**, the Canadian Cognitive Abilities Test (CCAT) was administered. This test measures verbal, quantitative and nonverbal reasoning abilities.

For **academic achievement**, the Canadian Achievement Test (CAT) was utilized. This test consists of two separate batteries measuring skills in reading (vocabulary, comprehension) and mathematics (computation, concepts, application).

To assess **affective perceptions**, several measures were employed:

a. *Perceived competence*: Harter's Perceived Competence Scale was used to measure students' self-perceptions in four areas (i.e., cognitive, social, physical and general).

b. *Self-concept*: Coopersmith's Self Esteem Inventories were employed to assess evaluative attitudes toward the self in social, academic, family and personal areas of experience.

c. *Locus of control*: Crandall's Intellectual Achievement Responsibility Questionnaire (IARQ) was administered to examine students' beliefs regarding responsibility for outcomes in academic achievement situations.

To measure **cognitive strategies**, several tests were selected or developed:

a. *Reading awareness*: Paris' Reading Awareness Questionnaire was utilized to examine students' awareness of the evaluation, planning, and regulation skills involved in reading.

b. *Reading strategies*: A cloze task was developed to evaluate students' reading comprehension abilities and strategies. It is a procedure in which words

are systematically omitted and students are required to fill in the blanks with the appropriate words.

c. *Comprehension monitoring*: An error detection task was designed to assess students' comprehension monitoring skills. This task requires students to detect anomalous information in the passages; their awareness of faulty comprehension is taken as a measure of their comprehension monitoring.

d. *Perceived problem-solving ability*: Heppner and Petersen's Problem-Solving Inventory (PSI) was adopted to examine the underlying dimensions of students' perceptions of their real-life, personal problem-solving process.

e. *Problem solving strategies*: A problem-solving task was developed to assess students' problem-solving strategies in mathematics. This task requires students to think aloud (verbalize their thoughts) as they try to solve the given math problems.

To test the effects of the experimental programs, most of the above measures were implemented in both the pre-test and post-test phases. Measures of cognitive strategies, however, were not available at the pre-test point and were thus administered at the post-test point only.

**Assessment of participants' perceptions**

In addition to the above criterion measures, participants' perceptions with respect to their involvement in the Cognitive Education Project were also assessed by survey questionnaires.

Questionnaires were developed to ascertain the perceptions of the teachers involved in each condition of the Cognitive Education Project and were administered on an annual basis. The purpose of these questionnaires was to determine the teachers' perceptions of the project, including support and consultation provided by the team, test administration concerns, usefulness of test data provided, pupil behavioral change, inservice effectiveness, appropriateness of experimental program to variation in grade, class size, and time allotted for strategy instruction. Also, a follow-up teacher questionnaire was administered after the completion of the study.

A questionnaire regarding the principal's perception of both the implementation of the experimental programs and participation in the Cognitive Education Project was distributed to all principals on an annual basis. A follow-up survey was also administered to principals of experimental condition schools after the completion of the project to determine their perceptions regarding their involvement in the study.

With respect to parents' perceptions, a questionnaire was sent to all subjects' parents. In this questionnaire parents were asked if they recognized any positive changes in their child in the following nine behaviors: attention to homework, time spent on task, ability to accept criticism, willingness to tackle more difficult tasks, questioning, alternative points of view, self-confidence, originality in thinking, and vocabulary.

### Summary of methodology

The study involved the evaluation of two learning/thinking strategy teaching programs in comparison to traditional classroom instruction in elementary and junior high schools in north-central Alberta. Teachers received inservice training and then taught the programs for a period of two years. Strategy instruction was followed by one year of maintenance, during which all strategy instruction was withheld. Nine hundred pupils comprising gifted, average, and learning disabled students were initially identified to be followed. Change with respect to cognitive ability, reading and math achievement, affect, perceived competence and cognitive strategies in reading and math was evaluated over the course of the three years. As well, the perceptions of teachers, administrators and parents with respect to the two experimental programs were assessed.

## Results

The results of the study are discussed in terms of the effects of the two cognitive education programs and conventional instruction on student performance in four major areas: cognitive ability, academic achievement, affective perceptions, and cognitive strategies. The major analyses were two-way ANOVAs with the first factor being experimental group (I.E., S.P.E.L.T., Control) and the second a repeated factor being the testing periods.

### Grade 4 results

In the following sections, the results are reported first for the learning disabled, then for the average-achieving, and finally for the gifted students.

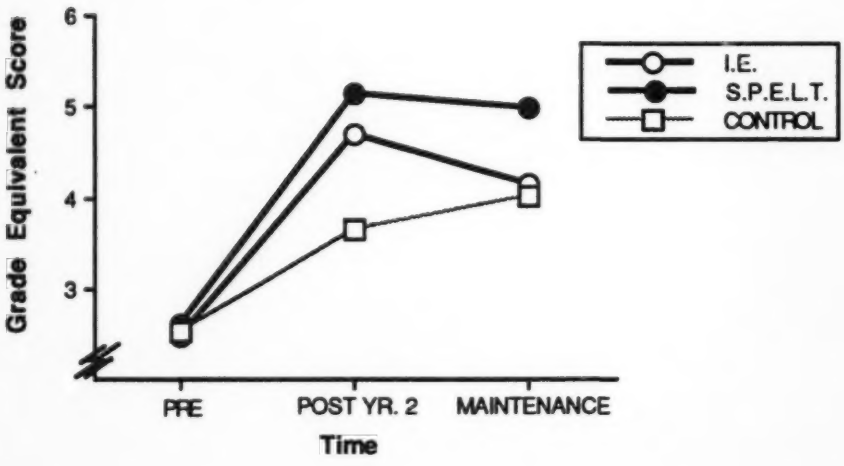
### Learning disabled

For the learning disabled students at the grade 4 level, a number of experimental program effects were observed, except for the cognitive ability measure. The most pervasive experimental effects were observed for **academic achievement**, particularly in the area of reading comprehension. Figure 1 shows that both I.E. and

S.P.E.L.T. students appear to display greater gains in reading comprehension grade scores after two years of cognitive instruction when compared to their control counterparts. However, I.E. students appeared to regress during the maintenance period performing at essentially the same level as Controls by the end of the three-year period. S.P.E.L.T. students on the other hand, demonstrate little change during the maintenance period and after three years of instruction are performing at about one grade level higher than both I.E. and Control students.

**Figure 1**

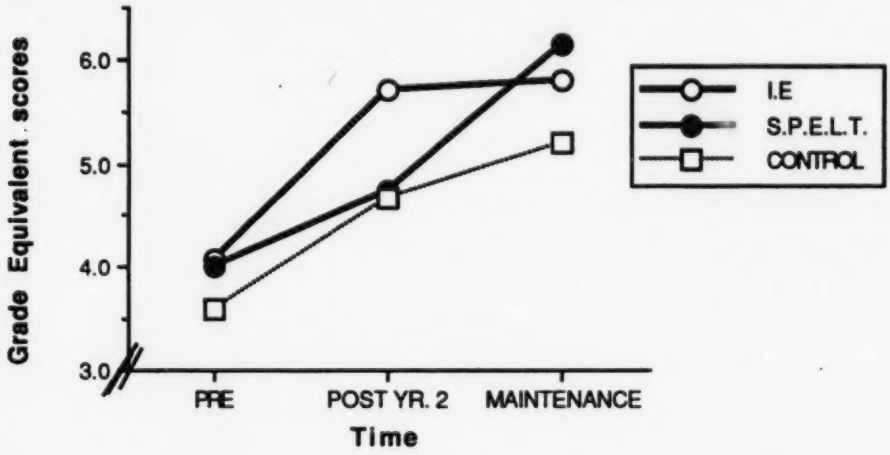
**Reading Comprehension: Grade 4 Learning Disabled**




There were also program effects observed for math concepts and application. The results indicate program impact as both the I.E. and S.P.E.L.T. groups show increased performance over the Control group at the end of the maintenance year (see Figure 2).

**Figure 2**

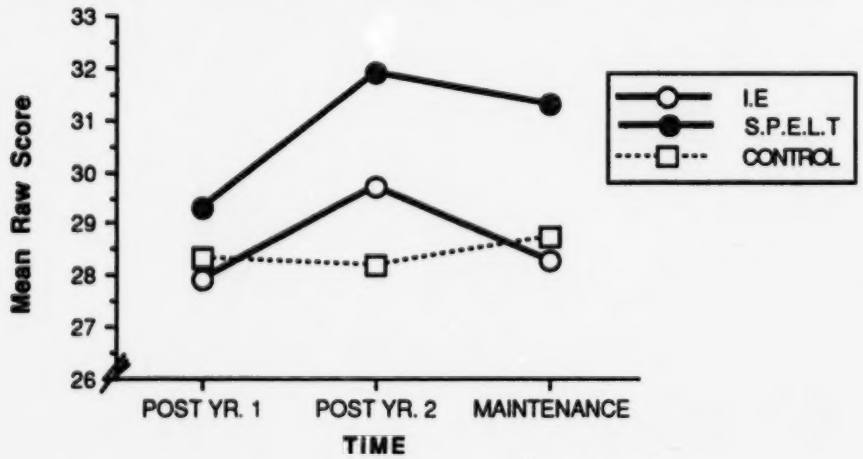
**Math Concepts and Application: Grade 4 learning disabled**




The standardized reading achievement changes were coupled with changes in related strategy areas of reading most notably in **metacognitive reading awareness** (see Figure 3) and to a lesser extent in cloze performance and comprehension monitoring. These related effects were more consistently observed for S.P.E.L.T. students. This might be expected since many of the reading strategies taught in the S.P.E.L.T. program were more directly related to reading tasks than are those in the I.E. program.

**Figure 3**

**Metacognitive Reading Awareness: Grade 4 Learning Disabled**



Also, the improvement of math problem solving skills of the I.E. and S.P.E.L.T. students was coupled with some changes in the frequency of **math strategies** used in solving individual problems. This was particularly true for the S.P.E.L.T. students who displayed a greater frequency of use of the reread strategy as well as the strategy stating a plan during problem solution.

In terms of affective perceptions, there were no significant program effects observed with respect to changes in students' perceived competence or self-concept. However, experimental effects were observed with respect to **locus of control**. The S.P.E.L.T. and I.E. students displayed an increase in overall internal locus of control after the two years of instruction.

In short, the general effects revealed here provide a reasonably optimistic picture regarding the impact of cognitive education for students with learning difficulties in regular classrooms.

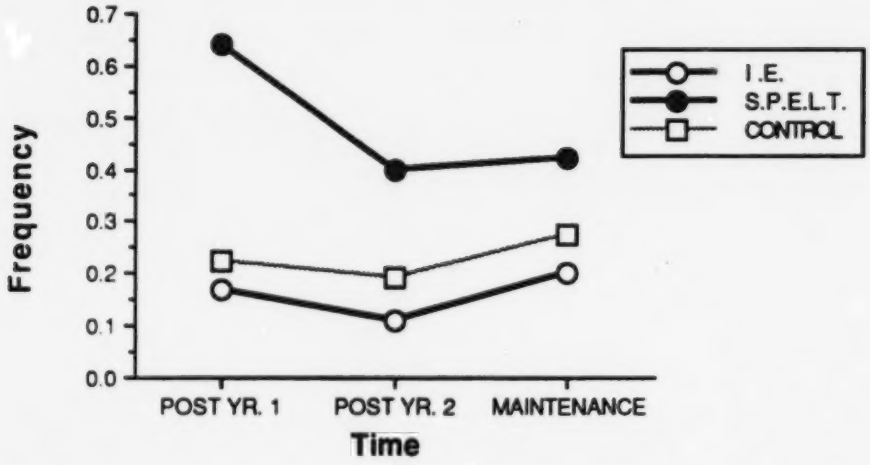
**Average–achieving**

For grade 4 average-achieving students, the results indicated that the groups were performing at essentially the same level on the cognitive ability measure at both pre and post-test.

With respect to academic achievement, no significant program effects were observed. Differences between groups in frequency of different strategy use when solving math problems were observed. For example, a significant group main effect, as well as a group–by–time interaction, was obtained for the strategy of "stating plans". Figure 4 displays the results. It appears that the interaction is due to the behavior of the S.P.E.L.T. students. After one year of instruction S.P.E.L.T. students displayed a higher frequency of use of the strategy as compared to both I.E. and Control students and this tended to endure over the three years. There was also a greater overall frequency of use of a reread strategy observed for S.P.E.L.T. students as compared to both control and I.E. students.

**Figure 4**

**Math Strategy (Stating Plans): Grade 4 Average Students**




With regard to affective perceptions, little effect was observed with respect to self-concept and perceived competence. There were, however, experimental effects obtained with respect to **locus of control**. After the two years of instruction both S.P.E.L.T. and I.E. students displayed a greater degree of internal locus of control than students in the traditional program.

**Gifted**

For the grade 4 gifted students, the results indicated some changes in student performance in terms of **cognitive strategies** in the area of reading comprehension and, to some extent, in math problem solving.

Specifically, the reading **cloze** performance of both I.E. students and S.P.E.L.T. students was better than for Controls particularly by the end of maintenance year (see Figure 5). This was coupled with improved **comprehension monitoring** for both S.P.E.L.T. and I.E. students as well as a trend for increased metacognitive reading awareness. Ceiling effects were observed for the standardized reading measures, thus no significant increases could be expected with respect to the standardized measure of reading.

**Figure 5**

**Cloze (Synonyms): Grade 4 Gifted**

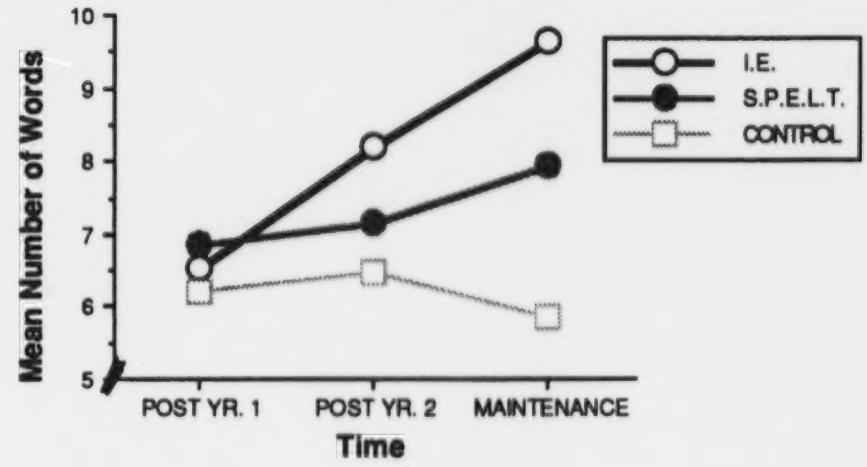
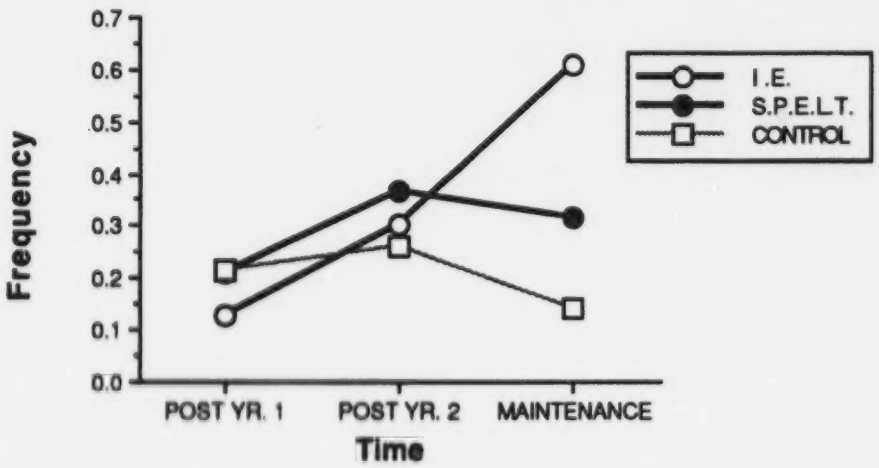



**Figure 6**

**Math Strategy (Determining Alternative Ways): Grade 4 Gifted**




I.E. and S.P.E.L.T. students displayed greater frequency in the use of the strategy of determining alternative ways of solving a problem as well as the strategy of determining the reasonableness of an answer when confronted with math word problems. For the strategy of determining alternatives, both S.P.E.L.T. and I.E. students demonstrated greater use of determining alternative ways of solving problems,

particularly at the end of maintenance (see Figure 6). This is clearly the case for I.E. students who displayed an increasing frequency of use of this strategy over time.

Regarding affective perceptions, there were no significant program effects observed with respect to changes in students' perceived competence, self-concept or locus of control.

**Grade 7 results**

The results for the grade 7 students are presented in the same order and format as was the case for the grade 4 students.

**Learning disabled**

For the learning disabled students at the grade 7 level, no significant program effects were observed for verbal or quantitative scale scores of the cognitive ability measure. However, a significant group-by-time interaction was obtained with respect to non-verbal ability. The interaction appears to be due to an increase in non-verbal ability for the S.P.E.L.T. students as compared to I.E. and Control students who performed essentially at the same level or decreased slightly. The pre-test to post-test means for I.E., S.P.E.L.T., and Control were 98.8 to 101.3, 103.2 to 108.3, and 98.5 to 99.8 respectively.

With regard to academic achievement, trends toward program effects were observed for reading comprehension and vocabulary, the findings displayed some changes as a result of program implementation and this was particularly true for S.P.E.L.T. students (see Figures 7 and 8).

**Figure 7**

**Reading Comprehension: Grade 7 Learning Disabled**

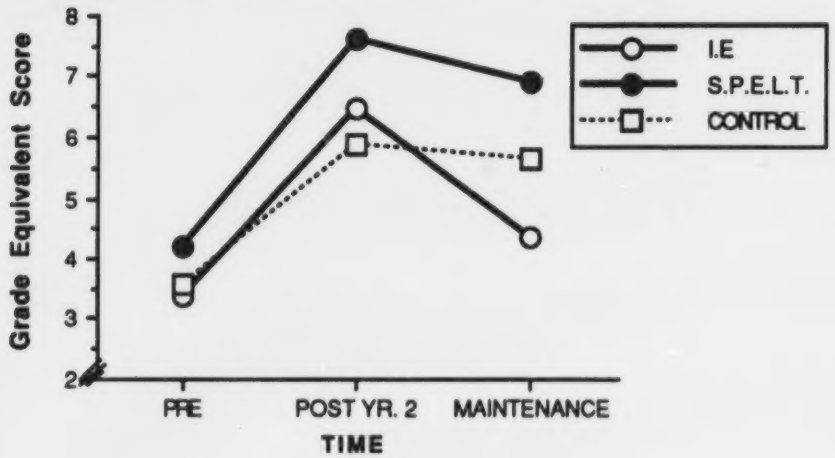
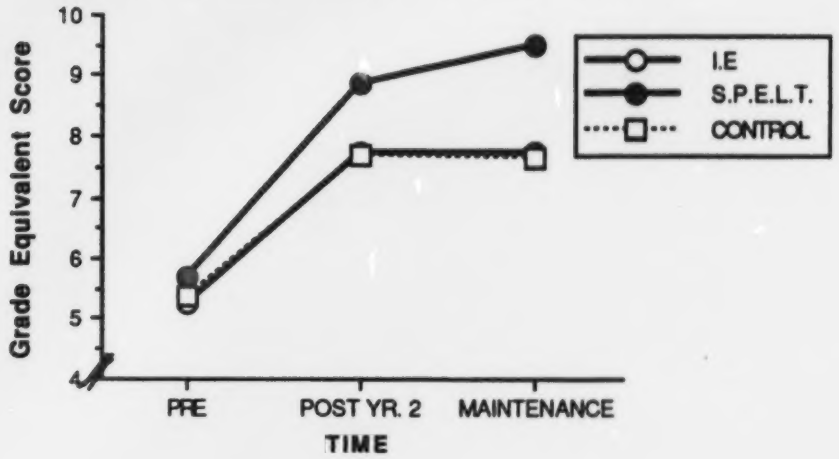



**Figure 8**

**Reading Vocabulary: Grade 7 Learning Disabled**




Changes were also observed after two years of instruction for standardized measures of both math computation and math concepts and application. I.E. students performed better in math computation than either S.P.E.L.T. or Control students at the end of the two years of instruction, but this difference disappeared at the end of

maintenance. This pattern for I.E. students was also observed for math concepts and application.

For the measures of affective perceptions, the experimental programs appear to have had little effect on the perceived competence, perceived problem solving ability, and self-concept of adolescent learning disabled students over a three-year period of time. However, the degree of internal **locus of control** was affected for students in the S.P.E.L.T. program more so than I.E. or Control students.

In terms of cognitive strategies, the reading and math related strategy measures displayed some changes as a result of program implementation. This was particularly true for S.P.E.L.T. students. Although the results were not consistently significant, the majority of trends indicated changes in favor of the experimental students.

**Average-achieving**

There were few obvious experimental effects observed for grade 7 average achieving students. There was some indication of increased reading performance in using contextual strategies in reading after the three years (as measured by the cloze task) for S.P.E.L.T. students as compared to I.E. and Control students. Few other significant effects were observed.

**Gifted**

The results for the grade 7 gifted students displayed some interesting patterns. There were some changes in achievement in math computation and math concepts and application. The standardized math computation performance of the I.E. students, and to a lesser extent the S.P.E.L.T. students, appeared to be affected after two years of instruction. The gains over the two years for I.E., S.P.E.L.T., and Control students were 2.9, 3.0 and 2.6, respectively. These differences tended to disappear at maintenance with Controls doing better. However, ceiling effects were beginning to play a part at both the end of two years and at maintenance. The math concepts and application performance appeared also to be affected to some extent by both I.E. and S.P.E.L.T. teaching. The gains, after two years of instruction for I.E., S.P.E.L.T., and Control, were grade equivalents of 2.0, 2.0 and 1.1, respectively.

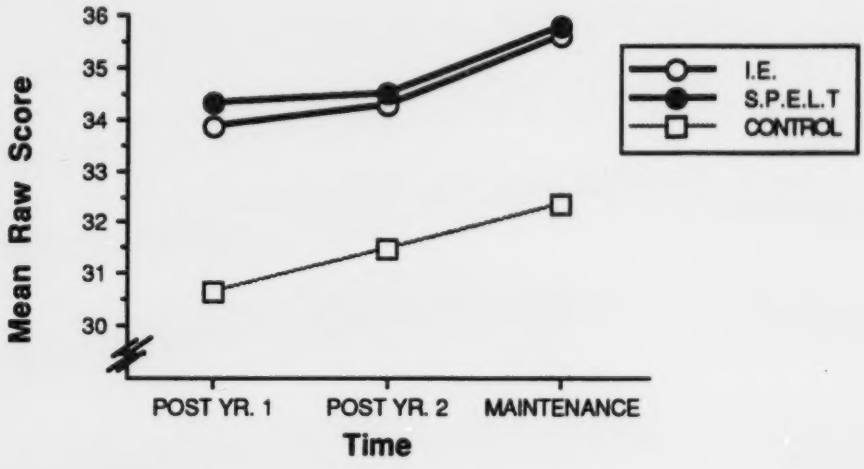
With respect to reading performance, there were no significant effects observed for standardized measures of reading. This is to be expected since the level of performance by all of the gifted students was high at the outset.

There was, however, evidence for positive change in metacognitive reading strategy awareness for both I.E. and S.P.E.L.T. students. The means for I.E., S.P.E.L.T. and Control students were 34.6, 34.9 and 31.5, respectively. Overall the two cognitive

education programs appeared to significantly affect gifted grade 7 students' **metacognitive awareness** in reading. After approximately six months of instruction, the metacognitive reading awareness of these students appeared to be enhanced by both experimental programs and this difference was maintained over time (see Figure 9).

**Figure 9**

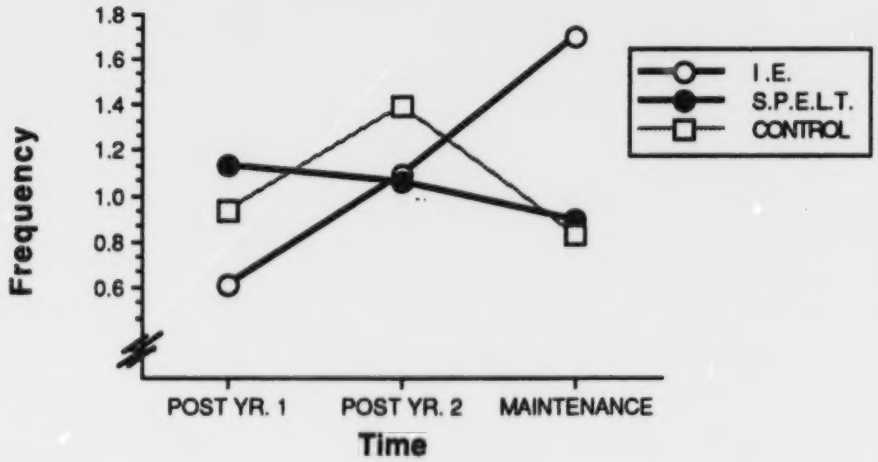
**Metacognitive Reading Awareness: Grade 7 Gifted**




The **math strategies** students chose to use in solving particular math problems also demonstrated some experimental effects particularly for I.E. students and to a lesser extent S.P.E.L.T. students. For example, a significant group-by-time interaction was obtained for the frequency of usage of the **rereading strategy**. At the post year 2 point, while Control and I.E. increased, the S.P.E.L.T. score remained relatively stable. At maintenance, the interaction was due to increasing I.E. scores compared to decreasing S.P.E.L.T. and Control scores. The I.E. students displayed greater usage of the **rereading strategy** as compared to both Control and S.P.E.L.T. students after maintenance (see Figure 10).

**Figure 10**

**Math Strategy (Rereading): Grade 7 Gifted**




Finally, with respect to affective perceptions, no significant program effects were observed for any of the three measures of affective perceptions.

## Participants' Perceptions

In order to monitor and evaluate the evolving perceptions of each of the participating groups (teachers, principals and parents), with respect to their involvement in the Cognitive Education Project, survey questionnaires were developed and administered to each group on an annual basis for three years. Presented here are summaries of the information gathered from these surveys.

### Teachers' perceptions

The perceptions of the participating teachers were extremely positive for both I.E. and S.P.E.L.T. Immediately at the end of implementation and project involvement, all teachers in S.P.E.L.T. and the majority of I.E. teachers indicated that they would like to continue using the procedures. When asked one and a half to two years later, a significant number of teachers (85%) indicated they were indeed teaching certain aspects of the program to their classes. All the teachers in I.E. and S.P.E.L.T. indicated that they would recommend their respective programs to their colleagues and furthermore, that involvement in the training had enhanced their professional

development. The inservice training and follow-up support were also considered to be appropriate. In addition, some teachers indicated that more inservice days spread over the year after the initial three-day inservice would have been more beneficial. Teachers generally felt that both experimental programs were effective for all student ability levels, although some I.E. junior high teachers indicated that the program was most appropriate for low ability students.

**Principals' perceptions**

Very few differences were noted between the questionnaire responses given by the S.P.E.L.T. and the I.E. principals. Generally, principals involved in the experimental conditions viewed their teachers as being relatively enthusiastic about the project both at the conclusion of the inservice and over the course of the year.

Problems were noted for scheduling and implementation in the I.E. condition. While I.E. principals encountered difficulties in the scheduling and implementing of the required three forty-minute classes outside of the regular curriculum, this was not the case for S.P.E.L.T. principals. I.E. principals reported both personal and teacher frustration arising from these timetabling difficulties. Such problems apparently affected grades 7 and 8 more frequently than the grades 4 and 5 classes.

**Parents' perceptions**

The perceptions of parents with respect to changes in their children suggested that there were generalizing effects being observed at home. A number of behavioral changes were related and were consistently being reported more often by I.E. and S.P.E.L.T. parents than Controls. The most frequently reported behavioral changes over grades were in **attention to homework**, in **recognizing alternative points of view**, in **willingness to tackle more difficult tasks**, in **self-confidence**, and in **questioning**. The parent data strongly support the idea that program effects are being generalized for both S.P.E.L.T. and I.E. students, particularly after one year of instruction and at the end of maintenance.

## Summary of Results

**Student change**

The results appear very promising, particularly for learning disabled students and to a somewhat lesser extent gifted students (see Table 2). The most pronounced effects were observed for the grade 4 learning disabled students, most notably in reading comprehension and related strategies. There was also evidence that the average and gifted students benefited, but to a lesser degree. Generally, S.P.E.L.T instruction tended to produce more changes as compared to I.E. and Control. This finding was not unexpected since the S.P.E.L.T. instruction, in large part, involves teaching cognitive strategies directly within curricular content areas.

The lack of consistent maintenance of behavioral change, which was sometimes observed for I.E. students, may be due to insufficient time allotted for I.E. instruction. Maintenance of the program might well be achieved if I.E. instruction could have been continued for a longer period of time.

This study is a highly conservative one, as in most cases only one or two teachers in a school, at one grade and subject level, taught either the I.E. or S.P.E.L.T. program. If all teachers at each grade level were engaged in the teaching of cognitive education procedures, quicker and more comprehensive effects would likely have emerged. There is some evidence for this expectation in a study conducted in Barrhead and Swan Hills schools in 1985 (Mulcahy, Peat, & Darko-Yeboah, 1986). All teachers from grades 4 to 12 were trained in cognitive education procedures, with pre- and post-tests administered to students during the initial year. Significant pre-post gains were noted on measures of self-concept, perceived problem solving, metacognitive reading awareness, and strategy use.

The results obtained in the present study are also consistent with findings from recent research on the teaching of metacognitive strategies (Paris & Oka, 1986). Haller, Child and Walberg (1988) conducted a meta-analysis of twenty studies of metacognitive strategy teaching with respect to reading comprehension which involved a total of 1,553 students. They obtained an average effect size of .71 which they report as one of the largest uncovered in educational research to date. This supports the claim that metacognitive strategy teaching is effective in making children more aware of reading strategy variables.

**Table 2**

**Summary Chart of the Three-Year Results**

| | | Program Effect | | |
|---|---|---|---|---|
| Variable | Grade | Learning Disabled | Average | Gifted |
| ***Cognitive Ability*** | 4 | No | No | No |
| | 7 | No | No | No |
| ***Academic Achievement*** | | | | |
| Math Computation | 4 | No | No | No |
| | 7 | Yes(1) | No | Yes(1,2) |
| Math Concepts and Application | 4 | Yes(1,2) | No | No |
| | 7 | Yes(1) | No | Yes(1,2) |
| Reading Vocabulary | 4 | No | No | No |
| | 7 | No | No | No |
| Reading Comprehension | 4 | Yes(2) | No | No |
| | 7 | Trends(2) | No | No |
| ***Affective Perceptions*** | | | | |
| Perceived Competence | 4 | No | No | No |
| | 7 | No | No | No |
| Self Concept | 4 | No | No | No |
| | 7 | No | No | No |
| Locus of Control | 4 | Yes(1,2) | Yes(2) | No |
| | 7 | No | No | No |
| ***Cognitive Strategies*** | | | | |
| Reading Strategies Awareness | 4 | Yes(1,2) | No | Trend |
| | 7 | No | No | Yes(1,2) |
| Reading Cloze Performance | 4 | Yes(2) | No | Yes(1,2) |
| | 7 | Yes(2) | Yes(2) | Yes(1,2) |
| Comprehension Monitoring | 4 | Yes(2) | No | Yes(1,2) |
| | 7 | Yes(1,2) | No | Yes(1,2) |
| Math Problem Solving Strategies | 4 | Yes(2) | No | Yes(1,2) |
| | 7 | Yes(1,2) | No | Yes(1) |
| Perceived Problem Solving Ability | 4 | No | No | No |
| | 7 | No | No | No |

1= I.E., 2=S.P.E.L.T., 3=CONTROL

**Participants' perceptions**

The perceptions of parents, teachers and administrators regarding the two cognitive education programs are extremely encouraging. The vast majority of experimental teachers reported that they would continue to use the instructional procedures from the two programs. Indeed when a significant number was surveyed again in November 1988, two years after involvement in the project, over 85% of the teachers reported they were continuing to use aspects of the programs in their teaching. This was coupled with the fact that all teachers indicated they would still recommend the programs to their colleagues.

Parents' responses, although limited to the second and third years, also indicated positive changes in their youngsters, in a number of important behavioral areas such as **self-confidence, task persistence, accepting alternative points of view, originality of thinking,** and **questioning.**

Administrators' perceptions of the two experimental programs were also generally very positive. Some concern was evident with respect to the high cost of I.E. materials as well as the practice of teaching I.E. in isolation from the rest of the curriculum. However, on follow-up questionnaires, one and one-half to two years after their involvement in the initial implementation, over half of the 24 principals said they would consider adopting the experimental programs. Many of these principals stated they would also recommend the cognitive education programs to other schools.

**Inservice training**

With respect to the inservice training provided for the two experimental programs, the vast majority of the teachers indicated that inservice training was sufficient to allow them to implement the programs adequately. There was some indication from a number of teachers that more "in-school support" would have enhanced implementation of the programs. A feeling of isolation (being the only teacher in the school involved), was voiced on occasion by some teachers. The administrators and other staff were not familiar with the programs. Nevertheless, teachers were able to learn and implement the programs with some degree of facility. The need to have all staff become familiar and involved from the beginning of the program was evident.

The teachers in both experimental programs indicated the desirability for additional follow-up inservice sessions over the years. This could be handled to a considerable extent through peer coaching and staff meetings devoted to discussion of teaching procedures, and generalization over content areas and grades.

## Implications

### Cognitive education as a part of school curriculum

The results observed with respect to pupil change, coupled with the perceptions of parents, teachers and administrators, suggest that the teaching of learning/thinking strategies should be made an integral part of the school curriculum.

The question of whether the cognitive education programs are more appropriate at different grade levels or for different diagnostic groups could not be answered definitively. However, instruction at the lower grades was associated with better gains than instruction at the higher grades. The results clearly indicate that both programs have a greater effect on students at the grade 4 level. The teachers involved in the experimental conditions also indicated general appropriateness of both programs for grade 4 students. Both programs appear to be most effective for grades 4 and 7 learning disabled students and to a lesser extent for gifted students. It is somewhat puzzling that there appeared to be less impact on average students as compared to learning disabled or gifted students. This may be due to the fact that learning disabled students generally lack a systematic strategic approach to tasks and thus benefit more quickly when provided with a systematic approach. Average students may already have a somewhat effective approach in place, and thus fail to benefit significantly from the programs at the outset. Gifted students have the intellectual ability to perceive the usefulness of the strategies and then to use and extend them immediately. Many of the teachers commented that they found the higher ability students to "take off" with the strategies in extending and applying them.

### Cognitive education for students

The results have clear implications for the mainstreaming of students with learning difficulties, as well as gifted students. The impact of the teaching of cognitive strategies on the learning disabled students, particularly at grade 4, suggests that if the teaching approaches are used systematically throughout the elementary school, it may prevent some students from developing severe learning problems, and keep them in the mainstream.

The recent research on the teaching of learning/thinking strategies to learning disabled students also demonstrates significant effect with respect to achievement (see for instance Palincsar & Brown, 1984; Paris & Oka, 1989; Goldman, 1989). The

effects observed in this study for gifted students also indicate that they may benefit from such teaching in the regular classroom.

These approaches should also be effective for mildly mentally retarded as well as native youngsters in regular classrooms. Indeed some researchers have suggested this (Mulcahy & Marfo, 1987; Brown, 1984). There is a need for further research on teaching learning/thinking strategies for these populations. Further investigation into the effects of extending cognitive instruction to primary, senior high and post-secondary levels is also required. Current research at the preschool level with high risk children, appears to hold significant promise (Haywood, Brooks, & Burns, 1986; Price, 1991).

**Assessment of cognitive strategies**

The two cognitive education programs affected the cognitive strategies utilized by students after instruction as well as increased their degree of metacognitive reading awareness. The comprehension monitoring skills of students after two years of instruction in the two cognitive education programs were observed to be generally better than their control counterparts, and so was their performance on a cloze reading task. Both these tasks require students to use context to fill in missing words and to determine the comprehensibility of the text. As Paris and Oka (1986) have suggested, skimming, rereading, paraphrasing, inferring and checking are strategies that one would use on these tasks. No direct measures of these particular strategies were taken during the Cognitive Education Project. However, the changes in math strategies noted in I.E. and S.P.E.L.T. students were often those of rereading, stating plans and determining alternative solutions.

The assessment of cognitive strategies was addressed to some extent by the project. However, it may be that more pervasive strategic change could have been identified if more appropriate criterion measures of cognitive strategies were available. Further research must address the development of these instruments for researcher as well as practitioner use. The math problem solving strategy approach, the Metacognitive Reading Strategy Awareness Inventory, and to some extent, the Perceived Problem Solving Inventory, used in this study appear to hold some promise both from face validity and/or from results reported here and elsewhere.

## Reflections of the Research Team

The study reported here is a very extensive one involving an extremely large number of participants. When one is involved with such a large number of individuals over an extended period of time, there is a great deal of what might be termed *qualitative* data collected which can shed further light on the study about cautions which future studies of this nature can benefit from. The following provides some of this qualitative data from the perspective of the research team. There are essentially six major topics of importance related to the study which we feel merit attention: data interpretation, inservice training, implementation, program management, evaluation, and programs.

### Some considerations regarding interpretation

As with any study there are significant limitations which must be considered in interpreting the results reported. Among the more critical with regard to this study are: with the large number of statistical analyses significant results by chance are increased; specific tests of program mastery were not conducted independently by the research team so it is possible that all students may not have mastered the content of the experimental programs; the majority of situations involved only one experimental teacher in a school thus restricting the instruction to one classroom of students as well as the consolidation and generalization of the learning and thinking strategies; the small number of parent questionnaire returns in years two and three restricts the degree of confidence that can be placed on these results, however, the results at the end of one year of instruction can be viewed with confidence in light of relatively high rates of return; not all students had all measures available for analysis, however, missing data due to attrition, test administration, etc., is a significant problem and is particularly a difficulty in longitudinal studies; the use of grade equivalent scores as the dependent measures in some of the analyses could be criticized.

### Inservice training

Due to the large number of requests for inservice training in S.P.E.L.T., there has been much opportunity to modify and refine the S.P.E.L.T. inservice model. As well, through classroom observations throughout the four years of the Cognitive Education Project, insights were gained as to which aspects of inservice training were applied most frequently at the classroom level. The synthesis of this information is presented below.

S.P.E.L.T.'s three-phase approach to the teaching of learning/thinking strategies appears to be more important than the choice or sequence of strategies used. This

observation is strengthened by recent research articles which emphasize 'informed strategy training' (for example, see Nickerson, 1988). As well, there was a tendency for some teachers in the Cognitive Education Project S.P.E.L.T. condition to remain within the direct teaching of Phase I for extended periods of time, rather than moving to Phases II and III. In light of these factors, and based upon the responses of hundreds of teachers to the inservice training process, the inservice training model has been modified as follows:

a) Rather than spending each of the three days of training on each phase of the S.P.E.L.T. instructional model sequentially (i.e., Day 1=Phase I; Day 2=Phase II; Day 3=Phase III), the strategies are now presented in content-based clusters, with each cluster moving through the three phases. This results in teachers undergoing an experience with the S.P.E.L.T. instructional continuum a minimum of four times throughout the three-day training process. Although the number of strategies presented is reduced using this model, the importance of the instructional continuum is emphasized.

b) The emphasis on the instructional continuum, with multiple strategy clusters being presented, rather than the individual strategies, seems to eliminate the tendency of some teachers to emphasize only one area of strategy application such as reading comprehension or memory. In other words, the breadth of strategies used in classrooms appears to be greater than when the original inservice training model was used.

The five-day inservices for I.E. should be split into two- and three-day blocks in order for teachers to try the principles of I.E. before completing the entire training. In addition, two half-day workshops held at regular intervals would give teachers a chance to share problems and ideas and to renew their enthusiasm with respect to the program.

In order to ensure that teachers are able to acquire the necessary teaching skills and strategies regardless of the program, cognitive coaching should be made an integral part of the initial training. This coaching for application would involve hands-on, in-classroom assistance and cognitive modelling to transfer skills and strategies to the classroom. This could be achieved through the extended training of classroom consultants who could then work with teachers in the classroom on a continual basis after the initial inservice training. Peer coaching should also be made an integral part of the inservice training and extended into the classroom situation.

**Implementation**

The question of whether the programs were implemented as intended, was determined through on-site visits and phone calls. In the majority of cases the programs appeared to have been implemented adequately; however, it is clear that some teachers were implementing to a greater degree of intensity than others. Teacher enthusiasm with respect to the two particular approaches was extremely high, so it was difficult to control for the Hawthorne effect. However as has been pointed out by other researchers, it is unrealistic to expect these teachers to hide their enthusiasm. Moreover, teacher enthusiasm is useful evaluation data (Nickerson, 1986) indicating face validity of the programs.

It is also possible in the present study that the control group's performance was enhanced as a result of participation in the project. There were some indications from control teachers to suggest this. One particular comment voiced to the principal researcher was, "I bet my students will do as good or better than those students being taught strategies", suggesting that some control teachers may have viewed themselves in competition with the experimental groups. Even with the careful monitoring it is still possible that programs were not as systematically implemented as intended. In order to ensure maximum implementation it would be helpful to have peer teacher coaching made an integral part of the procedure. The first year could be a program implementation year and the following years, evaluation years.

When future studies of this nature are considered, it would be more appropriate to have the initial year as an implementation year where teachers are trained and monitored through the year and the coaching is developed as an integral part of the program. The succeeding years would then become evaluation years which would result in less confusion and more direct evaluation of program effects.

When inservice training pre-testing and implementation are all occurring at the same time, teachers, students and administrators as well as the research team are dividing attention and efforts towards many variables and as a result one or more of these areas suffers. If participants are able to concentrate on one aspect at a time, it is likely that more appropriate implementation might occur. Allowing the initial year to enable teachers to concentrate on implementing the procedure would result in less confusion. This would also enable the research team to engage in more in-class coaching and monitoring to assist in more appropriate implementation. This raises another problem that we ran into in the implementation which was a major concern for the teachers as well as for the research team. The feedback from a number of teachers in the field

indicated that they felt they were being torn in a number of directions simultaneously and thus were unable to put forth a concentrated effort to the implementation. One issue was that many districts had a particular focus one year with respect to the teaching and enhancing effectiveness and the next, a new thrust or focus would emerge. An example might be the emphasis on teacher effectiveness training and then next year focus on increasing students' self-esteem. What this tended to do was restrict teachers in the ability to implement the strategy teaching consistently over the years with a focused thrust. The comment was often heard, "we are being asked to do too many things at the same time with not a long enough period with any one focus to enable us to do the task adequately". The research is clear that the teaching of learning/thinking strategies is not a brief task but one that requires a long-term commitment over a number of years.

The experience gained through implementing this project pointed out a number of pitfalls that need to be avoided when schools or school systems contemplate putting in place a program of learning/thinking strategy instruction. Some of these have also been documented by Chance (1986).

There was often a tendency to move too fast or try to do too much in a short period of time. It was evident that in many instances too many cognitive strategies were attempted to be taught in a very short time. It is important to focus on a few strategies over the course of a year or term and teach them well.

It appeared in many cases that expectations for change were too high. The expectation of significant changes in a short period of time could have led to some disenchantment and the abandonment of the teaching or at the most a halfhearted effort. Cognitive strategy instruction is a long-term commitment and must be viewed as such.

Giving in to early failures can be a common problem. Instead of viewing these as failures, it is important to treat them as opportunities to learn more about cognitive strategy teaching. In these early stages of the development of cognitive instruction, mistakes and failures are to be expected and can be the vehicles for adding to our knowledge regarding how best to deliver cognitive education instruction. Just as we encourage students to use errors in their problem solving to assist them in their learning, so too should teachers of cognitive education.

**Program management**

Record keeping, collecting and scoring tests, and computerizing results were onerous tasks. The recording of what decisions had been made and why with regard to testing, inservice, questionnaire distributions, scoring, student attrition, assessment difficulties, and missing data to list but a few is a full-time job. It is necessary to keep

very careful written records of dates, times, decisions and individuals involved in order to be able to interpret study data in a realistic way. This is something that we in the study team did as consistently as possible. However, there were still times it was not totally clear what had happened and why.

Communication in a project of this nature is one of the key elements which can make or break the study. It is essential that all major participants are kept informed from beginning to end with respect to all aspects of the study. With a study of this magnitude, this is an extremely difficult task. At the very beginning in order to make explicit as possible each participant's role, a summary of the project was written up including questions to be addressed along with methodology. The particular roles and responsibilities of the school jurisdiction, teachers, and research team were clearly defined in this summary which was then provided to participants prior to involvement. A signed written contract from the participating school jurisdictions was then requested to ensure to the degree possible, the continued commitment for the three–year duration of the study. As well, some meetings were held with school boards, parents, and/or administrators to communicate the study's intent. In future studies, meetings of this nature should be an integral part of initial program management to ensure communication is appropriate and to address any questions or concerns.

Over the course of the study it is essential to ensure ongoing communication between the research team and field. We attempted to do this by requesting one contact person (usually an assistant or associate superintendent) to be assigned to communicate with the research team and teachers. In addition phone calls and newsletters were used to maintain contact with schools up to 80 to 100 miles away. In future, it may be useful to use a computer networking system with the schools and set up electronic bulletin boards where sharing of information could occur between the team and the field as well as between teachers in the field involved in the same program. This would allow a sharing of ideas with respect to program implementation as well as helping to maintain a focus on the implementation.

Following a small number of children out of a total classroom is extremely difficult, particularly over more than one year. Testing becomes disruptive to the entire class and teachers are unable to conduct group testing easily as they have to divide their time between those students being followed and the rest of the class.

When following these students into the next grade, significant difficulties were encountered with respect to both students and teacher. Typically students are reassigned to classrooms at the end of each year which means that a new group of students is formed each year. Thus some of the students had been taught the program for one year whereas

others had no knowledge of the program. In the project we attempted to have students move as a complete group to the next class, however, this was only achieved in a very small number of cases at grade 4. If this was not possible then those students who were being followed were kept together as a group in their new class. The teacher then reviewed the previous year's work emphasizing those aspects crucial to the program movement to the next level. Identifying teachers at the beginning who would become involved in the second year and training them in the initial year would be extremely helpful in having teachers ready to teach the next level of the programs. If all teachers were involved this would not be as much of a problem.

All of the testing would best be done by the research team to ensure consistency as well as greater validity and reliability of data. Teachers might best administer only those tests directly usable and interpretable by them.

**Evaluation**

In studies of this nature, the question of the most appropriate criterion measures is a major concern. We attempted to evaluate the program from a number of perspectives including the cognitive strategies employed by the students. There is a need in the continuing work of this nature to further develop instruments and techniques more sensitive to the development of learning/thinking strategies and their transfer.

In evaluating the implementation it is obvious to us that we have not been able to detect changes that may have occurred. Teachers would often comment that the implementation of the programs had positively changed their teaching style and the way they now viewed and interacted with their students. Many teachers teaching Instrumental Enrichment for example, indicated when visited in their classrooms that students who previously would not volunteer an answer in class or debate a point would now do so, thus increasing their confidence in their work. It would be extremely beneficial in future research to attempt to objectively document these reported changes both through classroom observation as well as test-retest data. This was not directly observable from our measures. A classroom interaction scale, evaluating those student-teacher as well as student-student behaviors one would expect should change as a result of the strategy instruction, would provide an important evaluation component which has been missing from intervention studies in the teaching of cognitive strategies.

In further studies attempt should be made to determine differential impact with respect to quality and degree of program implementation, as it appeared obvious that some teachers were clearly implementing with greater enthusiasm and commitment than others. This might be built into the initial design as a major factor to be evaluated.

As this study progressed we became aware of new instruments which may in future be excellent criterion measures of program impact. One such measure is the Learning Process Questionnaire (LPQ) (Biggs, 1985). This particular instrument evaluates students' learning motives and strategies in an interactive way and thus may be a very good measure of changes in motivation and strategy as a result of program implementation. The Structure of the Observed Learning Outcome (SOLO) (Biggs & Collis, 1982) method of determining students' levels of thinking in different content areas also appears to warrant consideration as an approach for evaluating students' learning with respect to the teaching of learning/thinking strategies. These measures should be explored along with others in future studies of this type.

One acceptable measure of program impact is the degree of interest generated as the project progresses and the willingness of other groups and individuals to commit resources and time to the program. There was a significant increase in interest exhibited locally, nationally and internationally by teachers, administrators, and researchers which has continued to grow. It is obvious that the study has now progressed to the diffusion stage where the teaching program (particularly S.P.E.L.T.) is now being incorporated at a variety of levels in different classrooms, school systems and universities.

**Programs**

The experience gained from working intensively with the two different programs was invaluable. The difficulties we encountered with implementing a program which takes time away from the content were many and varied. One major difficulty was with the conflict teachers felt with respect to covering the curriculum in order not to detract from their students' performance on the tests required by Alberta Education. The felt need to cover the curriculum content was so great that in many instances, it was obviously detracting from the implementation of the program in terms of time allocated as well as focus. This was particularly a problem with respect to Instrumental Enrichment but was also voiced by some teachers with respect to S.P.E.L.T.

Both the research team as well as teachers implementing the two programs observed that it may well be that the principles of the Instrumental Enrichment program might be utilized effectively with some students displaying particular cognitive deficits at initial stages and then the S.P.E.L.T. procedures could be brought in to further extend the principles developed through I.E. There might thus be a blending of both programs with S.P.E.L.T. assisting extensively in the bridging and extending of strategies to content areas.

Some teachers indicated that they would like to see the principles of teaching found in Instrumental Enrichment to be more freely allowed to be adapted or extended beyond the actual exercises and that the more important component was the mediated style of teaching. The program might well benefit from further development in a broader context.

A large percentage of teachers voiced their concern that their students were not being tested with respect to learning/thinking skills but rather on acquired knowledge of content and thus teaching learning/thinking skills had to be secondary to teaching factual knowledge with respect to curriculum content. If teaching learning/thinking skills is to become an integral and focused part of classroom teaching, then assessment of the acquisition and application of learning/thinking strategies must become a part of the evaluation of curriculum in schools. Until it is obvious that this is the case, the teaching of learning/thinking strategies will take a backseat to attempting to cram as much factual information as possible in order to answer content–based questions, thus contributing to the futile acquisition of "inert knowledge" which is adequate for the test but fails to be applied or evaluated beyond the test situation. This is not to suggest that teaching content is not important but rather a more prominent role will need to be given with respect to teaching the process of learning/thinking.

## Recommendations

Based upon the results of this study the following recommendations are made.

### Alberta Education

1. It is recommended that Alberta Education make the teaching of cognitive education procedures an integral part of the Alberta school curriculum for elementary and junior high students and, that this become policy. The vast majority of experts in the field indicate this should be integrated into content teaching. The results of this study would support this.
2. It is recommended that Alberta Education develop and make available appropriate resource materials for teachers to use in the teaching of cognitive education procedures.
3. It is recommended that Alberta Education develop and make available to teachers and school administrators cognitive strategy assessment instruments in differing content areas as well as affective domains. These should be appropriate for both formative and summative evaluation purposes. This assessment might be made as part of Alberta Education's ongoing program of testing for school jurisdictions.
4. It is recommended that Alberta Education make available to all its field consultants training opportunities in theory, research, and application issues relating to cognitive education procedures.

### Universities

1. It is recommended that teacher training programs in Alberta provide compulsory training in the principles and practice of cognitive education for all preservice teachers.

### School jurisdictions

1. It is recommended that inservice training be made available with respect to methodologies for teaching and evaluating learning/thinking strategies in classrooms.

**Joint university, Alberta Education and school jurisdictions**

1. It is recommended that a Cognitive Science Unit be established which would have the following as its major functions:
   (i) the inservice training of teachers;
   (ii) assisting in the development and implementation of preservice training courses at the university level;
   (iii) providing consultation to school systems regarding implementation and evaluation procedures;
   (iv) conducting basic and field research on the teaching and assessment of cognitive education procedures.

   The setting up of this unit should initially be a joint endeavor between Alberta Universities, Alberta Education, and school jurisdictions.
2. It is recommended that additional research be conducted regarding the efficacy of cognitive education procedures at primary and secondary levels as well as with different populations, particularly the mildly retarded and native students. There is at present little systematic research on the effectiveness of these approaches for these students in mainstream classrooms.

## Concluding Remarks

Education has tended to easily grab on to new instructional approaches, the most recent one being learning/thinking strategy teaching or in somewhat more popular terms "metacognitive instruction". This type of instruction, regardless of which particular program is used, attempts to teach students to plan, implement, monitor and evaluate specific strategic approaches to tasks. The recent literature, including this study, suggests that this type of instruction has the potential to make enduring positive changes with respect to student learning and problem solving (see for instance Haller, Child, & Walberg, 1988; Paris, & Oka, 1986, 1989; and Palincsar, & Brown, 1987). It is likely that no one particular, added–on program, at one instructional level, will provide the adequate emphasis needed. In fact, some experts in the field suggest that it may not be ***what*** you teach (in terms of particular strategies or materials used) but ***how*** you teach it that is most critical to positive student change (Nickerson, 1988). Many teachers in the study reported here would also support this view.

The results of this study are very encouraging. There are potential benefits to students and teachers of implementing cognitive education procedures in mainstream

elementary and junior high school classrooms. The study reported here suggests that a number of positive changes in student behaviors do occur for different types of learners. The approaches examined in this study, however, are only two out of a wide variety available and these two might best be viewed as initial attempts at teaching learning/ thinking which do hold some promise. Further development and evaluation is still necessary.

There are numerous questions still to be answered within the context of this particular study including developmental and individual differences of the different groups of students with respect to strategy and affect. As well, questions regarding more specific subgroup differences with respect to program impact are still left to be answered (e.g., those high in self-concept versus low, those high in external locus of control versus low, etc.). As well, examining subgroups of students who appeared to benefit to a greater degree than others and then attempting to determine why this is the case would provide additional insight into differential effects of program impact. These and other analyses would help to provide a more comprehensive picture leading to a better understanding of the specifics involved in this type of intervention. There are also many questions yet to be answered in future work including: How quickly should one introduce a new strategy? What is the most powerful way to obtain transfer and generalization? What is the best way to interface content and strategy? What is the most appropriate way to integrate affect and cognitive strategy teaching?

Despite the problems and unanswered questions we need to pursue metacognitive instruction in our classrooms. There is clearly the need to provide for a comprehensive integrated approach to the teaching of cognitive strategies across all levels of education beginning at kindergarten through to post-secondary. The most appropriate ways of doing this to enhance learning/thinking have yet to be determined. However, we do now know enough to begin to make a start.

## References

Biggs, J. B. (1985). *The Learning Process Questionnaire (LPQ): Users' Manual.* Hawthorn: Australian Council for Educational Research.

Biggs, J. B., & Collis, K. F. (1982). *Evaluating the quality of learning: The SOLO Taxonomy.* New York: Academic Press.

Brown, A. (1984). Metacognition: New insights into old problems? *British Journal of Educational Studies,* 32(3), 213–219.

Chance, P. (1986). *Thinking in the classroom: A survey of programs.* New York: Teachers College Press.

Feuerstein, R., Rand, Y., Hoffman, M., & Miller, R. (1980). *Instrumental Enrichment: An intervention program for cognitive modifiability.* Baltimore: University Park Press.

Goldman, S. R. (1989). Strategy instruction in mathematics. *Learning Disability Quarterly,* 12, 43–55.

Haller, E. P., Child, D. A. & Walberg, H. J. (1988). Can comprehension be taught? A quantitative synthesis of metacognitive studies. *Educational Researcher,* 17(9), 5–8.

Harter, S. (1982). The Perceived Competence Scale for Children. *Child Development,* 53, 87–97.

Haywood, C., Brooks, P., & Burns, S. (1986). Stimulating cognitive development at developmental level: A tested, non–remedial preschool curriculum for preschoolers and older retarded children. In M. Schwebel & C. A. Maher (Eds.) *Facilitating cognitive development: International perspectives, programs, and practices.* New York: Haworth Press Inc.

Heppner, P. P., & Peterson, C. P. (1982). The development and implications of a personal problem–solving inventory. *Journal of Counselling Psychology,* 29, 66–75.

Mulcahy, R., & Marfo, K. (1987). Assessment of cognitive ability and instructional programming with native Canadian children: A cognitive processes perspective. In L. Stewin and S. McCann (Eds.) *Contemporary educational issues: The Canadian mosaic.* Toronto: Copp Clark Pitman.

Mulcahy, R., Peat, D., & Darko-Yeboah, J. (1986). *Cognitive Education Project final report: The County of Barrhead #11.* Department of Educational Psychology, University of Alberta.

Mulcahy, R., Marfo, K., & Peat, D. (1984). *SPELT: A strategies program for effective learning and thinking. Research edition* (available from the Cognitive Education Project, Department of Educational Psychology, University of Alberta).

Nickerson, R. S. (1986). Why teach thinking? In J. B. Baron & R. J. Sternberg (Eds.) *Teaching thinking skills: Theory and practice.* New York: W. H. Freeman and Company.

Nickerson, R. S. (1988). On improving thinking through instruction. *Review of Research in Education*, 15, 3-57.

Palincsar, A. S., & Brown, D. A. (1984). Reciprocal teaching of comprehension—fostering and comprehension monitoring activities. *Cognition and Instruction*, 1, 117-175.

Palincsar, A. S., & Brown, D. A. (1987). Enhancing instructional time through attention to metacognition. *Journal of Learning Disabilities*, 20, 66-75.

Paris, S. G., & Oka, E. R. (1986). Self-regulated learning among exceptional children. *Exceptional Children*, 53, 103-108.

Paris, S. G., & Oka, E. R. (1989). Strategies for comprehending text and coping with reading difficulties. *Learning Disability Quarterly*, 12(2), 32-42.

Peat, D., Mulcahy, R., & Darko-Yeboah, J. (1989). SPELT (Strategies program for effective learning/thinking). A description and analysis of instructional procedures. *Instructional Science*, 18, 95-118.

Price, A. (1991). Teaching thinking to preschoolers. In R. Mulcahy, R. Short, & J. Andrews (Eds.) *Enhancing Learning and Thinking.* New York: Praeger.